IMPROVED AIRFLOW CONTROL IN HEATING AND AIR CONDITIONING UNITS

FIELD OF THE INVENTION

The present invention relates generally to airflow control in heating and air conditioning units, particularly for automotive purposes.

BACKGROUND OF THE INVENTION

The present invention relates to the field of directing ventilating air and airflow control in a ventilating, heating or air conditioning system. More specifically, the present invention relates to a structure and method to provide air flow mixture via an air mixer structure located within a blend door.

DESCRIPTION OF THE PRIOR ART

In automotive ventilating systems and in ventilating systems in general, air needs to be directed to desired areas through respective air passageways. The air can be directed via outlet means such as dampers, doors and various mechanisms so the area that the ventilating system designer desires to have the air proceed to is achieved under any selected design conditions. For example, a design may provide for heated or cooled air to pass through an area or zone where it mixes to provide a certain temperature of air based on the area in the passenger compartment of a vehicle to which the air will be finally directed.

Ventilating, heating and air conditioning systems in modern vehicles strive to provide a total interior climate control. Such systems maintain a desired temperature by delivering an appropriate mix of ambient, cooled and heated air to the vehicle interior. Such systems conventionally include an air duct, which is selectively connected to the external air or to the interior of the vehicle cabin, a fan for causing the air to flow, and an evaporator unit within the duct for cooling the air. The cold air output from the evaporator unit may be supplied directly to various outlets within the vehicle cabin or some of the cold air may be passed through a heating heat exchanger whose heated air

output is mixed with the cold air to provide temperature control of the air output to the cabin. Diversion of the cold air through the heat exchanger in some prior art is controlled by a so-called "blend door", which in one extreme position causes all of the cold air to flow through the heat exchanger and in the opposite extreme position causes none of the air to flow through the heat exchanger. In intermediate positions, different proportions of cold air and heated air can be provided.

In the invention of US Patent 5,988,263, issued November 23, 1999, Schwarz, an air flow mixer structure for a vehicle air conditioning system having a first conduit for a first air flow, a second conduit for a second air flow, an opening between said first and second conduits for merging said first and second air flows in a merging region and a common air channel for said merged air flows wherein the mixer structure is disposed in the first conduit for controlling the first air flow, the mixer structure having an air inlet region and an air outlet region opening into said merging region, the mixer structure comprising plural air passages disposed between said inlet region and said outlet region for dividing an air flow at said inlet region into plural air flows at plural said openings into said merging region is described. In figure 2 of US Patent 5,988,263 the air mixer structure is located apart from the blend door feature.

A further desired goal of such systems is to provide selected desired air mixing at the output of the flow mixture structure.

A prior art HVAC system is shown in Fig. 1. The HVAC system's core module 12 and air distribution module 30. Ambient outside air or recirculated interior air is directed to air inlet 14 and is subsequently directed through air-conditioning evaporator 16 by the HVAC blower (not shown). After the air exits from evaporator 16 to pass between point 19 and wall 20, part of the air is directed through cool inlet area 22- and part of the air directed to warm air passage 24. Inlet 22 and passage 24 are variable in area depending upon the position of air mix door 18. Air mix door 18 is hinged at 17 to pivot there

around and the position of air mix door 18 is directly related to the desired air temperature of air to be output to the interior of the vehicle. Thus, to obtain the maximum amount of cool air, air mix door 18 is rotated to maximize the amount of cool air inlet 22. If heated air is desired, air mix door 18 is rotated to create a warm air passage 24 thereby diverting a portion of the air flow exiting from evaporator 16 to flow through heater core 26 and duct the heated air through heated air inlet 28 An intermediate position of air mix door 18 facilitates a mixture of cool and hot air simultaneously entering air chamber 32 of air distribution module 30 to provide air at a desired temperature.

Air distribution module 30 typically has three designated outlets for delivering the conditioned air to different portions of the vehicle. These outlets are generally referred to as a defrost outlet 36 for delivering air to the interior surface of the windshield, vent outlet 40 for delivering air to the upper portion of the vehicle interior and a heater outlet 44 for delivering air to the foot wells of the vehicle interior. Valves 34, 38 and 42 are selectively positionable in closed, opened or intermediate positions to place the desired HVAC in the desired function. The HVAC system 10 is typically located in the center of the vehicle as are outlets 36, 40 and 44.

In the past, many HVAC systems have been devised wherein multiple chambers exist to provide heated and/or cooled air to different areas of the passenger compartment of the vehicle. A large housing space was thus needed in such systems. Typically, a control means has been used to regulate the positions of the outlet means, such as doors, to let air into mixing chambers where the desired air temperature for the different passenger compartment areas (for example, the front and rear passenger compartments) is achieved.

Doors are often used to allow air entry into multiple chambers, each chamber providing a certain temperature level of air for transport to its associated passenger compartment. This has meant that a front door and a separate 'rear' door, with appropriate air channeling mechanism, such as divided walls and the like, was needed to direct the desired temperature air to both the rear and front areas of the passenger compartment. The air flow mixer concept meant that air could reach the hot and cold flow already

partially mixed or turbulated. This mixing means that when cold air stream confronts warm air stream, the air intermingles more readily than in traditional systems. However, in the prior art systems, the mixing required a certain amount of space to confront the 'mixed' and 'non-mixed' air.

The present invention, therefore, solves the space problem by mounting an air mixer structure or 'baffle', and, in particular, a cross flow air mixer structure, or, cross flow baffle inside a door for automotive HVAC units. More specifically by locating the baffle inside the door (baffle/barrel door assembly) it reduces packaging space requirements, allows for the attachment of the baffle while allowing the door to function throughout its range of motion, and provides an easily manufacturable attachment means to locate or incorporate a baffle in a door, while providing for efficient mixing of air in the confined space of the HVAC unit.

OBJECTS OF THE INVENTION

In view of the drawbacks and disadvantages identified in the prior art, it is an object of the present invention to provide a simpler and more reliable mechanism for both mixing and controlling air in HVAC unit. The present invention, particularly in its preferred embodiments, solves the problem of the need for both a separate door and separate air mixer structure or 'baffle' within the limited packaging space of modern HVAC units. By providing for a blend door, or, more preferably, a blend barrel door, incorporating or including an air mixer structure or baffle, the present invention decreases the number of separate elements necessary to provide appropriate mixing of air, as well as simplifying, reducing the space requirements of, and reducing the overall cost of the system.

SUMMARY OF THE INVENTION

The present invention meets the above needs by providing an air distribution module for a vehicle heating, ventilation and air conditioning system wherein said module mixes hot and cold air streams in a small HVAC unit space, as well as directs the air in the HVAC unit for automotive use. The air of the airflow is mixed in the single chamber prior to distribution to the

front and rear passenger areas of a vehicle interior. The air distribution module preferably further comprises an evaporator means and heater means, more preferably a evaporator or heat core or the like. Preferably, an air distribution module for a vehicle heating, ventilation and air conditioning system in accordance with the present invention comprises a housing; a heating means; a cooling or 'evaporator' means; a door; a baffle; a first conduit for a first air flow; a second conduit for a second air flow; an opening between said first and second conduits for merging said first and second airflows in a mixing region. Preferably the baffle is located within the door, forming a baffle/blend door assembly.

As stated above, preferably, the air mixer structure is located within the blend door, more preferably within a blend barrel door, when used in automotive HVAC units.

In a preferred mode of operation, the blend door, and, preferably the blend barrel door, would be located downstream of the heater core and evaporator and would move between air passages for hot air from the heater core and cold air from the evaporator. The axis of the door would be downstream of the passages that are blocked by the door. Located or incorporated within the blend door is an air mixer structure 'baffle'. The baffle would fit into or occupy space in the interior of the door, and, preferably, fit into the door in the space between the triangular sides of the barrel. The baffle may be attached or functionally fitted into the housing; preferably the baffle is attached to the housing by means of sliding into housing surfaces located downstream of the passages that are blocked by the door. Also preferred is an air distribution module for a vehicle heating, ventilation and air conditioning system in accordance with the present invention wherein the barrel door is essentially in the shape of a 'slice' of a hollow cylinder closed on both ends. The shape has open space between the triangular sides and fits into the open space that, in the past, was essentially not used for packaging other components. This invention presents a solution to this problem by mounting an air mixer structure (baffle), preferably a cross flow baffle, in the essentially unused space inside a barrel door. The functions of

mixing the hot and cold air paths, performed by the baffle, and the directing of the mixed air, performed by the barrel door, are accomplished in much less packaging volume than if the two components were not located together or integrated.

In general, because the door must move through an arc to function and the sides of the door sweep through the area that would be required to mount an object inside the door, the present invention, with its baffle located within the barrel door, presents the advantage of not requiring as much packaging volume as is typically allowed in common HVAC architectures.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and inventive aspects of the present invention will become more apparent upon reading the following detailed description, claims, and drawings, of which the following is a brief description:

FIG. 1 is an elevational cross sectional view of an exemplary prior art HVAC;

FIG. 2 is an elevational cross sectional view of another exemplary prior art HVAC ;

FIG. 3 is an elevational cross sectional view of an exemplary HVAC in accordance with an aspect of the present invention;

FIG. 4 is a cross sectional view of another exemplary HVAC in accordance with an aspect of the present invention, and

FIG. 5 is a cross sectional view of an exemplary HVAC in accordance with an aspect of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there are a number of air outlets into the vehicle cabin and these outlets are connected to the air duct by a corresponding number of output ducts (two such ducts are shown in FIG. 1). A first upper duct 41 is disposed on the side of the system which will tend to provide cold air and the second lower duct 42 is disposed on the side of the system which will tend to provide hot air. Referring first to FIG. 1, an evaporator unit 1 has an input side 2. Air is urged into the input side 2 of the evaporator 1 by the

movement of a vehicle in which the air conditioning system is mounted, or by a fan (not shown). The evaporator 1 is disposed in an air duct 3 and the evaporator has an output side 4 from which emerges cooled air. The output duct 3 extends to a throat portion 5 which co-operates with a blend door 10. The blend door as shown in FIG. 1 is in a central position so defining, with one wall of 11 of the duct 3 a first conduit for cold air flow and, defining with the opposite wall 12 of the duct 3 a second conduit for air which will be heated. The second conduit leads to a heat exchanger core 20 which is supplied with hot water, for example from the engine of the vehicle, and which has an output side from which emerges a flow 21 of heated air. The flow 21 of heated air and a cool air flow 22 from the first conduit come together in a mixing region 24 of the duct 3. Two distribution ducts, 41 and 42 are shown in FIG. 1 and these, as has previously been discussed supply air outlets in different parts of the vehicle cabin, eg. passenger and driver's sides.

It would be understood by one skilled in the art that although some mixing of the hot and cold air flows will take place in the mixing region 24, nonetheless the flow resistance caused by the heat exchanger core 20 will substantially reduce the velocity of the hot air and, as a result, on the extreme left of the duct 3, as seen in the direction of flow, the cold air will predominate and, on the extreme right of the duct 3 as seen in the direction of flow, hot air will dominate. Thus distribution duct 41 is more likely to contain cool air and distribution duct 42 is more likely to carry warm air.

In Figure 2 is illustrated an HVAC system an air flow mixer structure 30 is provided in the second conduit of the air conditioning system, on the downstream side of the heater core. The air flow mixer structure has an inlet side 31, which is supplied in use with hot air from the heater core and has an outlet side 32.

In Figures 3 and 4, there is illustrated a barrel door 101, essentially in the shape of a 'slice' of a hollow cylinder closed on both ends 102,103. The inside surface of each of the 'triangular' sides 104,105 has slots 106,107.

The slots 106,107 end in semi-circular shape and accept a pin 108,109, and, in particular, a rounded or round pin, designed into the air mixer structure 110 or baffle. The slots locate the baffle with respect to the barrel door.

In Figures 4 and 5, there is illustrated a barrel door 101 and baffle assembly 110. The assembly is inserted into one side of the housing of the HVAC unit, preferably in a direction parallel to the axis of the barrel door. The housing engages or 'traps' the baffle into the slots in the barrel door by means of contacting surfaces 111,112 between the baffle and the housing. The contacting surfaces 111,112 are essentially in a plane parallel to the axis of the barrel door, but normal to the direction of the slot in the baffle. The envisioned structure is that the barrel door 101 would be located downstream of the heater core 113 and evaporator 114 and would move between air passages for hot air from the heater core 113 and cold air from the evaporator 114. The axis 115 of the door 101 would be downstream of the passages that are blocked by the door. The baffle 110 would fit into the door, in the space between the triangular sides of the barrel. The baffle 110 would attach to the housing 116 by means of sliding into housing surfaces 111,112 located downstream of the passages that are blocked by the door.

Preferably, the barrel door axis 115 is designed with a pin 117 that fits into a hole 119 in the housing. This locates the door, preventing movement in the plane of the slot on the door.

The opposite side of the housing is then placed over the barrel door/baffle to mate with the first side of the housing. This housing also has contacting surfaces to the baffle as described on the first housing. A second pin 118 on the axis of the barrel door fits into a hole 120 on the second housing 121, locating the barrel door along its axis.

In the preferred embodiments, the air mixer baffle is restricted or constrained, more preferably restricted or constrained in all directions and allows the blend barrel door to rotate about its axis.

The air mixer baffle is preferably designed so that it does not interfere with the motion of the barrel door.

The simplified HVAC unit provides a baffle/blend door assembly comprising an air mixer structure wherein the attachment means of baffle and barrel door is such that it provides for ease of assembly.

The attachment means of baffle and barrel door is such that it provides for ease of assembly. The baffle/barrel door assembly provides for smaller packaging volume with the same functionality as larger HVAC units.

The preferred embodiment of the present invention has been disclosed. A person of ordinary skill in the art would realize, however, that certain modifications would come within the teachings of this invention. Therefore, the following claims should be studied to determine the true scope and content of the invention.